Bringing Mathematics to Engineering: Online Learning-Teaching Model

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***Abstract*—Engineering and Mathematics are closely related, the latter being a fundamental tool and being also at the base of many, if not all, of the processes employed in the former one. Engineering in turn is a source of application for those mathematical concepts that are, sometimes, difficult to understand by undergraduate students in universities. Precisely, so that this relationship can be more fluid and comfortable for students in Higher Education, a group of European universities have teamed up around a project called EngiMath - Mathematics on-line learning model in Engineering education.**

Keywords—Erasmus+ Projects, Mathematics Curricula, Higher Education, Engineering Education, Teaching Methods, Learning Objectives, Math Skills, Educational Experiences

I. Introduction

From its beginnings, engineering has had strong connections with the so-called Science subjects in general and with Mathematics in particular, the latter being a fundamental tool in the whole diverse range of analysis and calculation processes that an engineer must carry out. Likewise, in recent years the idea that Mathematics is a tool through which we model and respond to real problems has been increasingly promoted, creating degrees of Mathematical Engineering in some universities.

However, such problems can correspond to a very complex nature, even presenting difficult challenges for an engineer, with the training he usually has. By this, we mean problems of a non-deterministic nature, for which classical mathematics is unable to provide satisfactory or more concrete answers; where the tools and resources provided by it are simply yet to be developed. Along with the above, it is known that there are many systems, whose evolution in time we do not know. This means that we are not certain of the totality of the variables that govern them or how they interact with each other, or we know them, but the relationships that define the dynamics of the system are chaotic in nature, which means - essentially - that we cannot predict its evolution in the long term, and we can only do so in a small neighborhood of a given time initially.

In response to these needs, various methods, theories and processes are emerging, such as the Fuzzy Systems, introduced by L. Zadeh, aimed at processing information and data affected by imprecision or non-probability uncertainty. Some of these new measures to give solution to these systems is formed, essentially, by monotonous and continuous measures but not necessarily additive, as, following the fuzzy example, the integral fuzzy, associated to a fuzzy measure, which is a non-additive operator and is constructed on the order structure on which it is defined and not on the vectorial structure, as is the case of the classical integral of Riemann or Lebesgue.

But without being necessary to arrive at concepts that we can qualify as high level of development, Mathematics is present in all degrees in Engineering in any university in the world. Normally, the subjects of Mathematics are placed in the first years of these degrees. And it is here that from the consortium we have formed, we see that Mathematics and its associated subjects are fundamental elements of engineering education and proficiency in the area is expected. Engineers are required to be analytical and be able to utilize their mathematical toolkit to solve problems that may be ill or well defined depending on the contextual situation of the engineer. Until quite recently the determination of learning was undertaken using face-to-face techniques such as hand written assessments, private and public communication and observation to name but a few. Assessment and program delivery underwent a seed change with the new millennium when Educational Authorities and Professional bodies adapted their validation and accreditation methods to include learning outcomes within programs of study. The assessment techniques within programs altered accordingly to address these requirements and forces have evolved within higher education to increase the on-line presence.

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